PREHOSPITAL CARE

Retrieval medicine: a review and guide for UK practitioners. Part 2: safety in patient retrieval systems

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Retrieval and transfer of critically ill and injured patients is a high risk activity. Risk can be minimised with robust safety and clinical governance systems in place. This article describes the various governance systems that can be employed to optimise safety and efficiency in retrieval services. These include operating procedure development, equipment management, communications procedures, crew resource management, significant event analysis, audit and training.

Retrieval is the deployment of a medical team from a specialist centre to another healthcare facility, with the aim of transferring seriously ill patients to definitive care. Several specialised retrieval teams exist in the UK to retrieve adults, children and neonates.

Patient retrieval is widely recognised to be a hazardous undertaking—both for patients and staff.[1 2] Staff are called on to work in an unfamiliar environment with restrictions on equipment, space and assistance. Patients require multiple movements, which may compromise monitoring, invasive lines, drains and catheters and are dependent on portable equipment, power supplies and gas supplies. These challenges are coupled with the hazards of vehicle transfer by land or air.

Unfortunately, despite the published guidelines,[3–6] many retrievals in the UK are still undertaken by junior doctors outwith organised and planned systems. This paper aims to describe clinical governance measures that can be implemented in retrieval systems to optimise transfer efficiency and the safety of patients and staff.

OPERATING PROCEDURES

Retrieval systems involve a large number of operational staff, both medical and administrative, many of whom may be seconded to the service for only short periods. Services also work with staff in referring hospitals, receiving hospitals, ambulance services and sometimes aircraft operators. As a result, there is considerable risk of error owing to the lack of familiarity and knowledge of working methods and lines of communication.

Systems of operation therefore require to be clearly documented in a comprehensive but concise fashion. Table 1 describes the operational issues that these procedures must cover.

These procedures will allow all involved in the system to be familiar with how it works and what to do if things go wrong. This optimises the speed and efficiency of service operation. They can also be used to form the basis of training, induction and assessment of new staff as in the London Helicopter Emergency Medical Service[7] and the Emergency Medical Retrieval Service in Scotland.[8] Formulating these operating procedures through consensus highlights the deficiencies in current systems and allows planning for contingencies in the event of adverse incidents, having established patterns of organised and safe practice during more routine work.

Familiarity of these procedures by referring hospitals facilitates improved and more appropriate referrals. It also helps referring clinicians prepare patients optimally before the team arrives and to have a more active role in assisting the retrieval team when they arrive.

Operating procedures are, however, dynamic, changing as a result of experience and new developments. An effective system must therefore be in place to communicate changes in practice to all relevant staff and organisations. In our experience, this is best done through website storage of operating procedures.[8] The London Children's Acute Transfer Service[9] has several operating procedures available online. They request referring clinicians to access and follow these protocols while the team is en route.

When working in the field, members of the team should be able to access the service's operating procedures. This can be done using modern technology, such as a personal digital assistant, but there should always be recourse to a manual (paper) backup in the event of technological failure.

EQUIPMENT MANAGEMENT

When caring for a seriously ill patient in hospital, several resources are taken for granted—for example, power, oxygen supplies and spare equipment in the event of failure. This is often not the case in the out-of-hospital environment, or in remote community healthcare facilities. Common equipment problems include

- power failure;
- oxygen depletion;
- missing equipment;
- lack of familiarity in use of transfer equipment;
- reliance on equipment to be supplied by other agencies when the equipment at hand malfunctions or is missing.

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Robust equipment management systems must be in place. Equipment should be selected on the basis of ease of use, weight, size and compatibility. Much can be said in favour of using transfer equipment of the same type as used in the team's base department to ensure familiarity with its operation. It is disappointing that since the establishment of critical care networks in England, commonality of equipment and joint purchasing has not become more widespread. This would definitely assist in improving staff familiarisation with standardised equipment and promote longer-term improvements in patient safety. Attempts are being made to achieve national consensus on critical-care transfer equipment in Scotland.

Equipment for all eventualities should be carried, but this must be balanced by limitations of weight. This is especially the case when patients are to be transferred by helicopter, where even small additional weights can reduce the fuel load and hence affect the flying range. The risks and capabilities of staff in carrying heavy equipment packs also need to be considered.

Kit checks should be rigorous. Missing or deficient equipment during a retrieval can be disastrous. Single person checks have been shown to be flawed, because of observer bias when carrying out sole repetitive tasks. Equipment pack checks are ideally carried out by two people using a ''check and response'' technique similar to that used by pilots carrying out aircraft checks.

After checking, external and internal compartments of equipment packs should be individually sealed—for example, with cable ties. This allows a rapid glance at the pack to confirm that it is complete and ready for mission. It also means that after retrieval, only compartments that have been opened need to be rechecked. However, there should be a system for regular equipment and kit checks and inventories. An audit trail to allow quality control measures should be put in place, in the event of deficiencies being highlighted in the system.

Equipment packs should be clearly labelled. Zips should be clearly marked, with labelled key rings showing their compartments' contents. This ensures rapid access to kit during transfers and allows non-team members to locate equipment when assisting.

Failure of power to electrical units is a common problem during transfers.[10] Battery-powered electrical items need to have a recharging policy—for example, each piece of equipment should be put on charge for a minimum period after each mission before it is re-used. Several spare units will be required to facilitate charging and going offline for servicing and repair. The potential for utilisation of vehicle and aircraft power supplies should be investigated on each transport platform. Spare batteries should be carried where possible.

Carriage of compact, emergency backup equipment should be considered in the event of vital equipment failure. An example is the Nonin capnograph, pulse oxymeter and heart rate monitor.[11]

Table 1 Examples of operating procedures

Referral policy	Clinical conditions and scenarios
Communications	Adverse incident reporting system
Personal protective equipment	Specialist equipment
Equipment packs	Monitoring
Drugs	Training policy
Land ambulances	Clinical management
Air transfer—helicopter and fixed wing	Documentation

Secure storage of equipment is important on land and air platforms. Each unit will otherwise become a projectile in the event of a collision or sudden braking. Items can be secured using equipment manufacturers' brackets or can be incorporated into specially designed trolleys. All require engineering tests to comply with European safety regulations.

Equipment to be used in aircraft must be secured to comply with Civil Aviation Authority regulations.[12] Electrical equipment must also be flight tested to ensure compatibility with the aircraft's avionics systems. Each unit must be tested separately on each aircraft used.

Pilots need to plan fuel carriage and aircraft flying range, crucial to which is an accurate weight of the load carried. All equipment packs should be clearly labelled with their weight, and each retrieval team member should know his or her own weight.

Other agencies should not be relied on for supply of equipment which may be vital. In case of relying on the ambulance service for oxygen or powered suction, this should be checked before departing with the patient. (This is based on the authors' personal experiences.) Other healthcare professionals may not appreciate how important these resources are for a critically ill patient, and their organisation may not adhere to systems of daily checks.

Team members should be aware of the volumes of different sizes of oxygen cylinders available and the oxygen consumption rates of ventilators used. Carrying a minimum of twice the anticipated oxygen required on transfers is necessary. Cylinder valves and keys should be carried.

PERSONAL SAFETY

The safety and well-being of the team is paramount. This is achieved through

- health and safety policies and procedures;
- training;
- appropriate personal protective equipment;
- personal injury insurance.

The service should have a regularly updated health and safety policy and risk assessment identifying all potential hazards to staff. Operating procedures for vehicles and aircraft used should emphasise the risks and safety aspects of each platform. For example, for helicopters these might include how to approach the aircraft, where to sit, how to operate the seatbelt and door locks, escape routes, brace position, life jacket use and communications in the aircraft.

The importance of secure equipment storage in vehicles should be emphasised. Instructions on appropriate speed and use of sirens and blue lights should be clearly stated to the driver before departure.

Adequate personal protective equipment should be made mandatory. A high-visibility jacket and steel toe-capped boots should be a minimum requirement for land transfers. For helicopter transfers flame retardant flight suits and aircraft helmets are essential, and if flying over water life jackets are also mandatory.

If regularly travelling over water in rotary aircraft, helicopter underwater escape training[13] is recommended. This can be combined with training in the use of short-term underwater air supply equipment. Immersion survival suits are required for prolonged flights over water.

Adequate insurance cover must be in place in the event of injury or death. In the authors' experience, many Trust policies for out-of-hospital work are for relatively small amounts. Each retrieval service should have its own insurance policy tailored to its own operations, risks and

staff. Staff should also be made aware of cover available through the National Health Service Injury Benefits Scheme[14] and professional bodies such as the Intensive Care Society[15] or the Association of Anaesthetists.[16]

COMMUNICATION

Reliable communication systems and equipment are necessary for safe and effective patient retrieval. A general principle is that communication should be directly between the most senior doctors involved. A system involving junior doctors taking the referring calls and passing second-hand information on to senior colleagues who make the decision whether to activate a retrieval or not should be avoided. Such systems are prone to important information being omitted or even false information subconsciously being added in transcription and relay. The referring doctor should also actually have seen and assessed the patient before making the referral.

If junior doctors undertake retrievals then they should have a direct line of communication to their consultant when in the referring hospital and en route.

Dedicated mobile phones preprogrammed with all appropriate numbers should be available. The mobile phone number of the retrieval doctor should be given to the referring doctor so that any change in the situation can be communicated to the retreival doctor while the team is en route. For retrieval systems operating in remote environments, use of satellite telephones may be essential.

During retrieval, the team will need to communicate with the referring centre and ambulance service personnel. Courteous, clear and concise communication styles are necessary to get the best performance from assisting parties; specific training should take care of this.

CREW RESOURCE MANAGEMENT

This practice was developed in the aviation industry and applies itself well to small teams involved in complex medical decision making and patient management. One of the main principles is that all members of the team should be used to their maximum potential. This includes, for example, delegation of tasks to the ambulance crew providing transport or nurses in the referring hospital.

More important is the concept that everyone involved has something to contribute to the retrieval. Everyone's experience should be taken into account: if the ambulance paramedic says the journey will take a longer time than the oxygen will last, then he will be right; if the auxiliary nurse notices that a power lead has fallen from the back of the monitor, then this opinion should be adhered to by the team leader and action taken. Everyone involved should be encouraged to contribute his or her opinion if it is important for the well-being of the patient.

The final principle of crew resource management is a structured approach to problem interpretation and solution. Many medical errors result from doctors not paying attention to the root causes of changes in patient physiology—for example, doctors persuade themselves that the monitor is faulty or the saturation probe is ''not picking up'', when in reality there has been a deterioration in the patient's physiological condition.

DEBRIEFING

Each retrieval is unique in terms of clinical and transfer challenges. Rarely does everything go as planned. It is useful to learn from every retrieval in a systematic fashion through a debriefing system.

The team should use a structured debriefing sheet, which breaks the retrieval down into its individual components. This structure should be used by the team after each retrieval to discuss what went well and what could be improved. Improvements can result from a change in an individual's practice or a need for a change in operating procedures or equipment.

ADVERSE EVENT MANAGEMENT

Similar to debriefing, an adverse event management system allows the retrieval system to learn from things that have gone wrong.[2 17] Everyone involved in the team should be able to report an adverse incident. Reporting should be a simple procedure with a clearly identifiable senior clinician responsible. There needs to be stratified levels of response to incidents and a clear communication system to allow dissemination of information and experience.

Major adverse incidents and repeated minor ones need to be rectified. If clinicians do not see any action being taken following their reports, they will stop reporting.

CASE REVIEW

Owing to the high clinical risk involved, retrieval teams should have regular clinical governance meetings. All members of the team and all relevant stakeholders should be invited. These meetings should include presentation of activity audits, changes in procedures and adverse incident reports.

In addition, it is useful to discuss at least one case in depth. Ideally, this should be a case which could have been improved on or one in which there is thought to be dubiety about the course of action taken. With several experienced clinicians present, these case reviews are invaluable in improving performance and identifying any need for change in practice. It is, however, essential that individuals are not apportioned criticism or blame during these reviews.

DOCUMENTATION AND DATA COLLECTION

Systems should be in place to ensure that adequate documentation of patient condition and management takes place during retrievals. Accurate and complete documentation provides information to the receiving doctor about the patient's status and about what interventions occurred before and during transfer. Other reasons for precise documentation include clinical governance and medicolegal purposes.

Ideally, all information recorded should be standardised and entered into a database after each mission to facilitate detailed service audit and to make information available for future research projects.

EXPERIENCE, TRAINING AND COMPETENCIES

Several national guidelines and training curricula describe the experience, training and competencies of those involved in undertaking transfers and retrievals.[3 4 6 18 19] Table 2 summarises the guidelines for training, experience and competencies in patient transfer. These guidelines generally state that the transferring clinician needs to be from a relevant acute specialty and needs to have specific training in transport medicine. Their base specialty is of less relevance than the existence of specialised training. Minimum required grades of doctors undertaking interhospital transfers are not stated in any guideline.

Specific training requirements, competencies and experience required for transfer are not consistent between guidelines. Australasian guidelines concentrate on organisational issues and ensuring that safe systems are in place, whereas the UK training guidelines focus almost solely on clinical patient issues. A combination of both would be the ideal.

Ideally, those undertaking retrieval of seriously ill patients should be consultants or senior trainees in relevant acute specialties. Training should include the following:

Table 2 Guidelines for training, experience and competencies in patient transfer

Institution	Grade and specialty	Training and experience	Required competencies
The Intensive Care Society[3]	A medical practitioner with appropriate training in intensive care medicine, anaesthetics or other acute specialty	Previous experience of transfer in a supernumerary capacity	Resuscitation Airway care Ventilation Other organ support Transport medicine Familiar with equipment
Intercollegiate Board for Training in ICM; general 6-month training in ICM[18]		Transfer and transport of critically ill patients requiring at least IPPV and invasive monitoring should be observed Familiarity with: physiological consequences of movement; environmental problems on the patient and equipment; minimal monitoring; pre-transfer assessment and resuscitation; routine intransfer care; choice and problems of equipment; intransfer emergency care	None stated.
Intercollegiate Board for Training in ICM. The CCST in ICM[19]		Interhospital transfers of patients on ventilation with or without support of other organ systems	Principles of safe transfer Understanding portable monitoring systems Interhospital transfer of patients with single or multiple organ failure Insistence on stabilisation before transfer Pretransfer checks Planning for and prevention of problems Communication Insistence on adequate support from senior colleagues
Joint faculty of ICM Australia[4]	None stated	Instruction in local retrieval systems; organisational matters; transport vehicle matters; team role and function; retrieval team personnel; health and safety; audit; quality improvement; infection control; equipment; ventilation; monitoring effects of altitude	None stated
American College of Critical Care Medicine[6]	Doctor or nurse with additional training in transport medicine	''…additional training in transport medicine.''	None stated

CCST, Certificate of Completion of Specialist Training; ICM, intensive care medicine; IPPV, intermittent positive pressure ventilation.

- Familiarisation with comprehensive standard operating procedures
- Familiarisation with all the equipment used by the service and that used by the local ambulance service
- Familiarisation with vehicle and aircraft used
- Personal protective equipment briefing
- Simulator training practising drills, such as equipment failure, endotracheal tube displacement, physiological deterioration and so on
- Undertaking several retrievals under the supervision of an experienced consultant.

In our opinion and experience, if a service is retrieving patients from remote sites with limited on-site specialists, investigative capabilities or preretrieval stabilisation, then the service should be consultant based.

CONCLUSION

Patient retrievals should ideally be undertaken by senior clinicians, with specific retrieval medicine training and skills operating in organised and well-governed retrieval systems.

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